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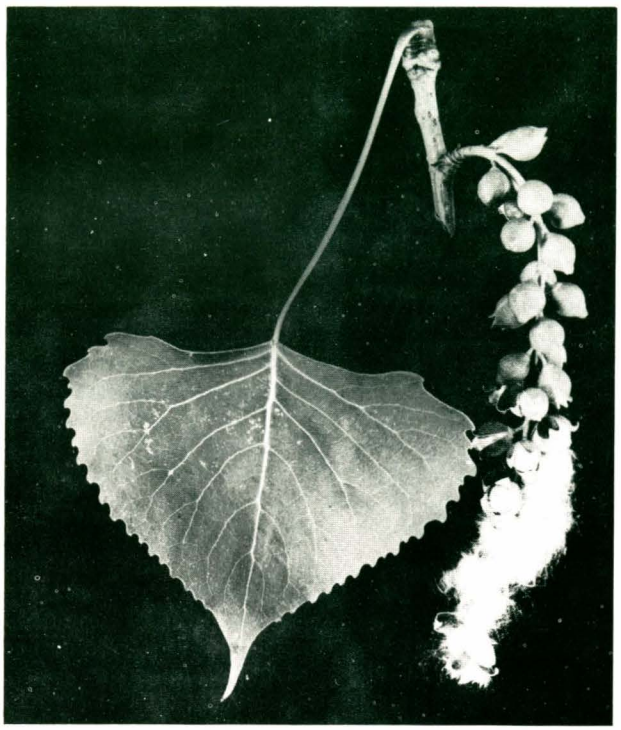
POPULUS

(cottonwoods, poplars, aspens)



F—490587

The genus *Populus* is widespread through the north temperate zone and has about 35 species variously called cottonwoods, poplars, and aspens. Some species form extensive northern forests up to the tree line, and others range south into northern Mexico, northern Africa, Himalayas, mainland China, and Japan. Six of the 9 species native in the United States are important in forestry.

These rapidly-growing deciduous trees have gray furrowed bark and resinous buds covered by several overlapping scales larger toward the pointed apex. The alternate leaves are generally broadly ovate, with blunt teeth or none, sometimes lobed, and the petiole is usually long, often flattened.

Drooping catkins of many flowers, mostly minute and greenish or reddish, are borne in early spring before the leaves, with the male and female on different plants (dioecious). The fruit, maturing in spring or early summer, is composed of many small rounded or egg-shaped capsules each containing many minute seeds with long white cottony hairs.

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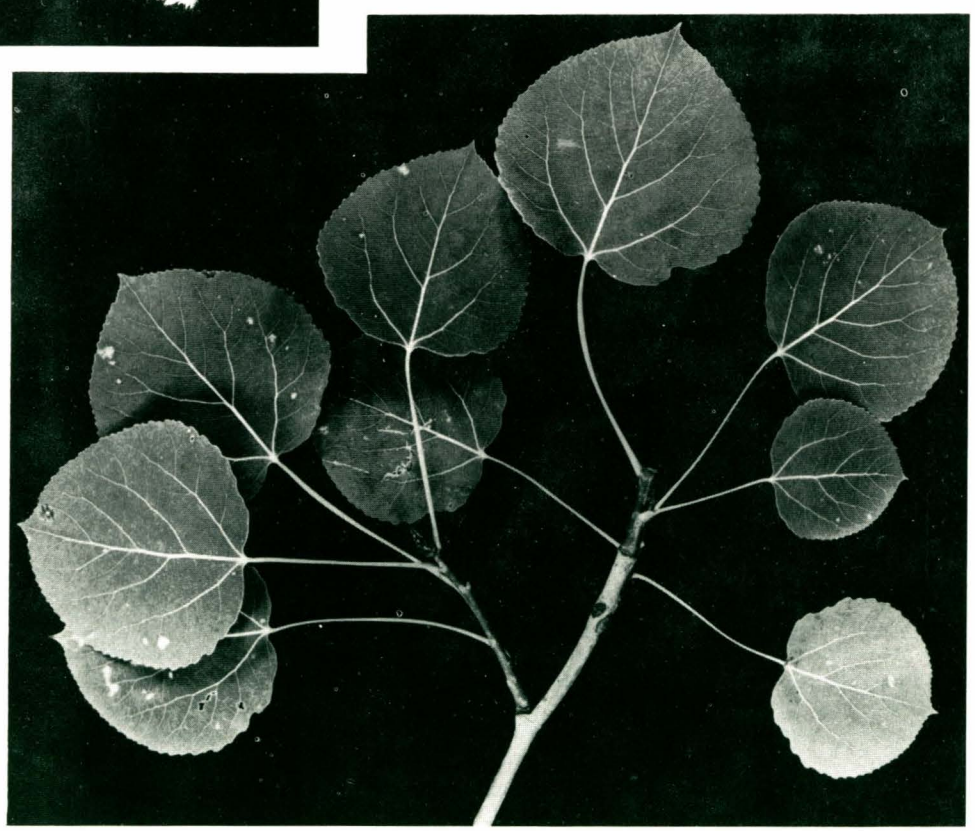
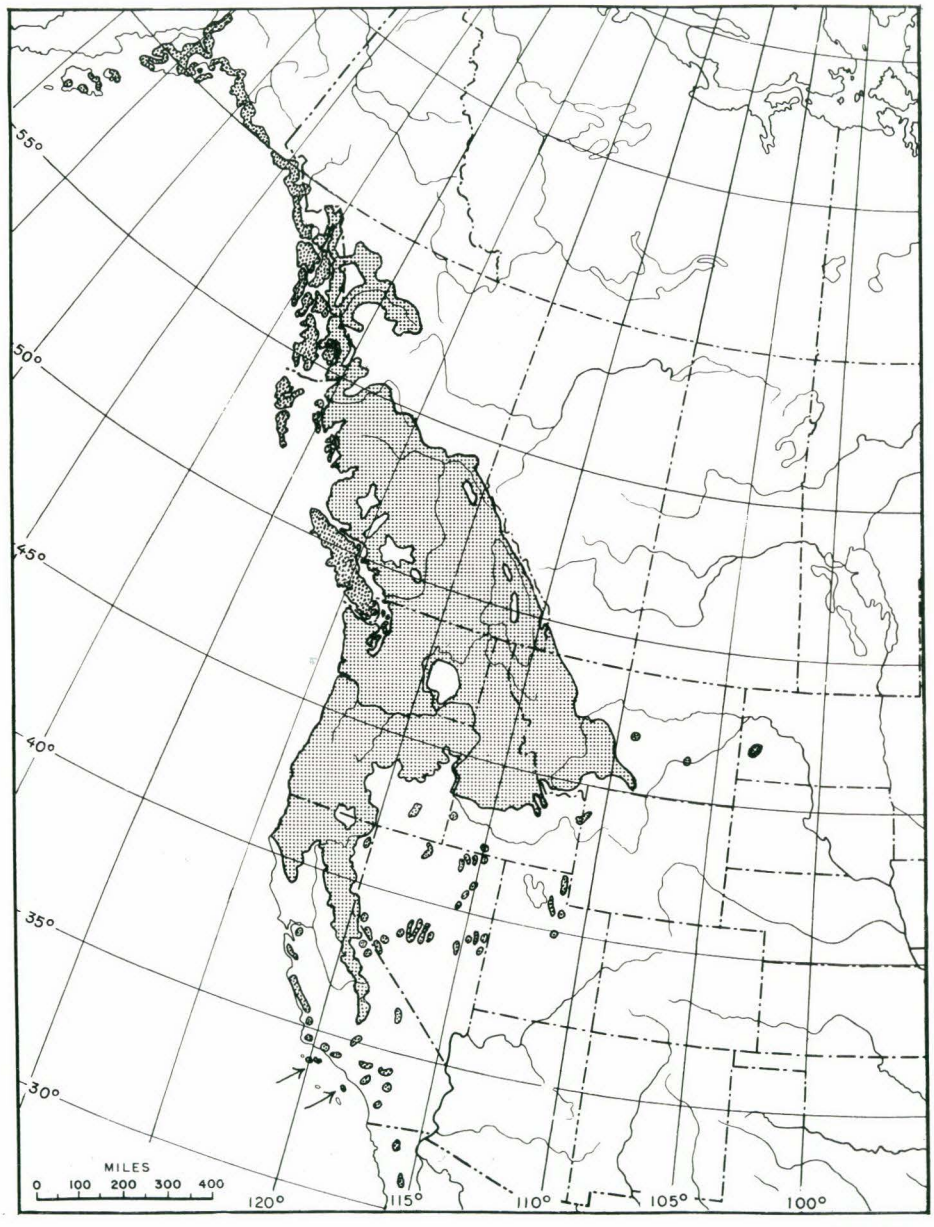


BLACK COTTONWOOD (*Populus trichocarpa* Torr. & Gray)

Other common names: California poplar, cottonwood, balsam cottonwood, and western balsam poplar.

Black cottonwood, largest of the American poplars, grows best in the forests of the Pacific Northwest, where it is also the largest hardwood in the region. The range of this species extends south along the Pacific Coast from Kodiak Island and southeastern Alaska to mountains in southern California and northern Baja California, Mexico. It is widely distributed throughout British Columbia except in the northeastern part. Its range extends eastward into southwestern Alberta (south to the Oldman River) and to south-central Montana, central Idaho, northern Utah, and



The range of black cottonwood.

Nevada. It is found mostly on bottom land, river bars, and forest meadows and streambanks, but it occurs throughout the plateau lands in north-central British Columbia (*3*, *4*, *7*, *13*, *15*).[1] It may be local east to western North Dakota.

HABITAT CONDITIONS

Climate

Black cottonwood grows where the climate varies from relatively arid to humid, but it develops best in a humid climate such as that found in the Pacific Northwest.

Maximum temperatures range from 60° to 117° F., and the minimum temperatures range from 32° to −53°. Average annual July temperatures are from 53° to 76°, but average January temperatures may be as low as 47° to 18°. The growing season varies from 72 days to 263 days. Average annual precipitation ranges from 10 inches to 126 inches. Much of this precipitation falls as snow and usually only about one-third of it falls from April through September.

Soils and Topography

Black cottonwood grows in soils ranging from moist gravels and sands to rich humus soils and occasionally clay soils. The largest trees grow at low elevations on deep alluvial soils. At higher elevations the species grows in moist sandy, gravelly, or loam soils. In Glacier County, Mont., black cottonwood is restricted generally to loam soils along streams and around ponds (*5*). Studies made in British Columbia (*11*, *12*) show that black cottonwood requires abundant moisture, nutrients, and oxygen in combination with a high pH for optimum growth.

Optimum pH is believed to lie between 6.0 and 7.0, depending upon the nutrient composition of the soil. Canadian studies (*11*, *12*) further point out that—

1. At least 18 inches of loam or heavier soil is required for good growth if this soil is underlain by gravel.

2. Lack of aeration limits growth. Stagnant pools and fine sediment deposited by flooding tend to reduce aeration and shorten the effective period of growth. Conversely, flooding by fast-moving water rich in oxygen speeds growth. Soils frequently flooded may be young and poorly developed, and the site quality may change each time flooding occurs. The poorest quality soil is found in newly formed gravel bars.

3. Some upland soils can support excellent growth of black cottonwood. These include wind deposited soils high in calcium and other nutrients, if they receive abundant rainfall; glei type soils of the glei layer is fairly deep and if the pH is reasonably high; some loams and loamy sands belonging to the "brown soil" group; and heavy clay soils if their structure is modified by incorporated humus.

In the northern end of its range, on the Kenai Peninsula in Alaska, black cottonwood occurs from sea level up to 2,000 feet elevation; up to 5,000 feet in Washington; and up to 7,000 feet in the valleys of the Selkirk Mountains in British Columbia. In California, it is most abundant at 3,000 to 6,000 feet, but it will grow up to 9,000 feet. In the drier areas black cottonwood usually grows in protected valleys and canyon bottoms, along streambanks and edges of ponds and meadows, and on moist slopes at the foot of the mountains where the roots can reach a relatively permanent supply of soil moisture (*5*, *15*).

Associated Trees and Shrubs

Black cottonwood is an integral member of the Black Cottonwood—Willow Type (Type 222) and the Cottonwood—Willow Type (Type 235). It is listed as an associate species in 3 types: White Spruce—Birch (Type 202), Poplar—Birch (Type 203), and Red Alder (Type 221). It occurs in mixture with Douglas-fir, western white pine, western larch, subalpine fir, white spruce, Engelmann spruce, western redcedar, western hemlock, white fir, red alder, Sitka alder, vine maple, bigleaf maple, several birches, and many willows, aspen, Oregon ash, black hawthorn, and other bottomland species. Black cottonwood meets with balsam poplar in Alaska and in the Yukon Territory and northeastern British Columbia, and the plains cottonwood in western Alberta and central Montana (*5*, *11*).

Ecological studies made in Glacier County, Mont., recognized a *Populetum-Osmorhizetosum* association (*5*). The most prominent plants were *Populus trichocarpa*, *P. tremuloides*, *Osmorhiza occidentalis*, *Viola canadensis*, *Smilacina stellata*, *Pedicularis bracteosa*, and *Heracleum lanatum*.

Studies in British Columbia (*11*) have demonstrated the feasibility of using indicator plants found among the lesser vegetation to indicate site quality as follows:

Good site quality—Salmonberry (*Rubus spectabilis*)—stinging nettle (*Urtica* spp.)—fern site. At least one of the above designated plants must be present in some quantity. The fern may be either swordfern (*Polystichum munitum*) or ladyfern (*Athyrium filix-femina*). Vigorous growth of hazel and elderberry shrubs also seems to be associated with an excellent growth of cottonwood.

[1] Italic numbers in parentheses refer to Literature Cited, p. 513.

Medium site quality—Red-osier dogwood (*Cornus stolonifera*), black twinberry (*Lonicera involucrata*), and waxberry form the dominant element of the shrub layer. Thimbleberry (*Rubus parviflorus*) and wild rose (*Rosa mitkana*) are also commonly found on this site.

Poor site quality—This site is often indicated by the common horsetail (*Equisetum arvense*). Land of this site quality is usually much below average quality and is subject to flooding for as much as six weeks in an ordinary year. The common horsetail and the tall horsetail (*E. hymenale*) do not always indicate poor sites because they may be present on layers of clay deposited over fine sand or silt or higher ridges or edges of water courses which may be of medium or better quality. In a few instances, poor and scrubby growth of the medium site indicators has been associated with soil layers deposited over poor site quality lands.

The following additional species also may give some clue to good growth potential for black cottonwood: jewel weed, hedge nettle, enchanter's nightshade, golden saxifrage, buttercup, bitter cress, angelica, loosestrife, bedstraw, cleavers, giant fescue grass, and tall hair grass (*11*).

The presence of tall reed grass, iris, spirea, or sphagnum moss may indicate acidic and excessively moist ground where conditions are not suitable for the growth of black cottonwood (*11*).

In Inyo County, Calif., aspen, willow, California black oak, interior live oak, water birch, cascara buckthorn (*Rhamnus purshiana*), and dogwoods (*Cornus* spp.) are common associates. On the Modoc National Forest, Calif., willows aspen, Pacific dogwood (*Cornus nuttallii*), Klamath plum (*Prunus subcordata*), and common chokecherry (*P. virginiana*) are the predominant species found associated with cottonwood.[2]

LIFE HISTORY

Reproduction and Early Growth

Flowering, seed production, and dissemination.—Flowers of black cottonwood usually appear before the leaves (*5*). They may begin to form from April 10 until May 30 in Washington and Oregon, and sometimes as late as June 10 in Montana and Idaho. The fruit is ripe in Washington and Oregon between May 24 and June 27, but some years in Montana and Idaho it has not ripened until mid-July.[3]

Black cottonwood is generally a prolific annual seed producer. The seed is light and buoyant and can be transported long distances by wind and water. Natural seed dispersal begins from late May to early July.

Seedling development.—The seed is highly viable, but under natural conditions, its germinative capacity is retained for only a brief period. However, it may be stored for 3 months to a year under refrigeration at low humidity (*11*). If the seed falls on a moist seedbed, high germination results. For germination wet river bottoms are the best, but moist, bare, humus, or sandy soils such as those in streambanks and bottom lands are also good (*4*). When seedbed conditions are favorable, seedlings appear in great numbers, but they thin out naturally by the time they reach 5 years of age due to the suppression of the weaker seedlings.

Black cottonwood does not reproduce satisfactorily on logged-over land unless special measures are taken to provide the bare, moist seedbed required for initial establishment.

Black cottonwood makes very rapid juvenile growth on good moist sites. Dominant and codominant seedlings in the Pacific Northwest on Lady Island near Camas, Wash., had a diameter of 6.7 inches at breast height and a total height of 48.5 feet in 9 years (*10*).

Vegetative reproduction.—Black cottonwood sprouts readily both from stumps and roots and is easily reproduced by cuttings (*7*).

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Black cottonwood seedlings on soil bared by flooding.

[2] Berry, James B. Black cottonwood. U.S. Forest Serv. Silvical Rpt., 4 pp. (Typewritten) 1911.

[3] Unpublished phenological data from the Pacific Northwest Forest and Range Expt. Sta., Portland, Oreg., and the Intermountain Forest and Range Expt. Sta., Ogden, Utah.

Cuttings should be made when the tree is dormant. They can be from 6 to 12 inches long, although longer cuttings may be desirable to make later cultivation easier. The position in the crown from which cuttings are taken is important to subsequent survival and growth. Cuttings of 1- and 2-year-old wood from the leaders and 1-year-old wood from primary side branches give best growth and survival. Cuttings from 2-year-old wood on side branches grow much slower. Best results are obtained when the cuttings are rooted for one year in the nursery before field planting. Spring is the best season for planting to avoid frost heaving, particularly on the heavier soils (*11*).

Sapling Stage to Maturity

Growth and yield.—In the Willamette Valley, Oreg., black cottonwood matures in 60 years or less, but on the Modoc National Forest in California best development is not reached until about 75 years (*8*).

A maximum diameter of 24 inches and a total height of 60 feet was reported in Inyo County, Calif. On the Klamath National Forest, Calif., trees grow 8 to 13 inches in diameter and 30 to 50 feet tall in 20 to 27 years; mature trees may reach 24 to 30 inches d.b.h. and 50 to 60 feet high. In Glacier County, Mont., trees growing in groves on Babb loam and stony loam soils were 12.8 inches in diameter and 45 feet tall when 82 years old. (*5*). The Montana trees were growing on the eastern extremity of the range of cottonwood bordering the grasslands and in a semiarid climate.

Exceptional growth of four selected individual trees in the Fraser Valley of British Columbia has been reported (*11*), as follows:

Age (years)	*Diameter breast high (inches)*	*Total height (feet)*
7	7. 0	45
17	18. 6	95
17	22. 4	85
27	32. 5	120

Detailed studies of the yield of black cottonwood trees made in the Quesnel region (Fraser River) in British Columbia show that the species grows well up to about 200 years old. In open mature stands the stem tapers only slightly, and is without branches for more than one-half its length; it then divides abruptly into large branches in the crown. In closed stands the crown is narrow, and persistent branches only rarely extend into the lower two-thirds of the bole (*14*). Tables 1 and 2 show basic growth and yield data for the middle Fraser region and Skeena River Valley in British Columbia.

Three site quality classes have been found satisfactory for use in British Columbia, as shown in table 3.

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Black cottonwood in Washington with relatively clean boles.

TABLE 1.—*Growth and yield characteristics for cottonwood in the Quesnel region, British Columbia* [1]

Total age (years)	Diameter at breast height	Height to base of crown	Gross volumes from stump height to a 10-inch top diameter	
	Inches	*Feet*	*Board feet* [2]	*Cubic feet* [3]
80	15	52	235	44
90	17	56	295	54
100	19	60	365	64
110	20	62	450	76
120	22	64	545	89
130	23	67	655	105
140	25	69	780	123
150	26	70	935	146
160	28	71	1, 110	173
170	29	72	1, 310	200
180	31	73	1, 520	225
190	32	73	1, 720	250
200	33	73	1, 920	273

[1] From Thomas and Podmore (*14*).

[2] Volumes according to British Columbia log rule.

[3] Smalian's formula.

TABLE 2.—*Yield per acre of black cottonwood in Skeena River Valley, British Columbia* [1]

Age (years)	Net volume per acre [2]	Mean annual increment per acre
	Board feet [3]	*Board feet*
20	4, 700	235
30	10, 000	333
40	16, 700	417
50	22, 800	470
60	27, 800	463
70	29, 400	420

[1] Data collected in the Skeena River Valley of British Columbia by W. C. Phillips for the British Columbia Forest Service (*11*).
[2] Trees more than 11 inches d.b.h.
[3] British Columbia log rule.

Reaction to competition.—Black cottonwood is the most shade-intolerant of its associates and is classified as being very intolerant (*1*). Because of this high degree of intolerance it can remain in the stand or in mixture with other species only so long as it occupies a dominant position. However, its rapid juvenile growth rate which exceeds that of most of its associates helps it to maintain a favorable position in stands.

Principal enemies.—Late frosts frequently kill or injure black cottonwood. Many cottonwoods were killed outright or killed back from 2 to 20 feet in height by a late fall frost in British Columbia in November 1955. Frost cracking damages cottonwood for some uses and provides entrance for decay fungi (*11*).

Because of their comparatively rapid growth, black cottonwood trees often project above the protection of surrounding trees. After they reach 80 feet or more in height, the wind frequently breaks off the upper third of the tree (*2*). In areas of heavy snowfall, saplings may be badly snow bent. Sleet storms also cause considerable breakage. Black cottonwood is highly susceptible to fire damage, and even light burns can cause considerable injury.

Several insects attack black cottonwood. Oystershell scale (*Lepidosaphes ulmi*) frequently kills twigs and branches and sometimes the whole tree. The satin moth (*Stilpnotia salicis*), introduced from Europe, was first reported in British Columbia and Massachusetts in 1920. It is now firmly established in Oregon and Washington, and feeds on many *Populus* species, including black cottonwood. The cottonwood sawfly (*Pteronidea* sp.) also feeds on black cottonwood leaves. Its reported distribution is limited to northern Idaho where it is common. A small cambium miner (*Laspeyresia populana*) breeds in the bark of black cottonwood in Montana. Several flat-headed and round-headed borers and the ambrosia beetles are known to attack the species, but these insects have economic importance as wood destroyers rather than as tree killers.

Black cottonwood is subject to several diseases. In the middle Fraser region, British Columbia, 70 species of fungi have caused decay in black cottonwoods. However, only six cause significant loss in living trees and, of these, two, *Polyporus delectans* and *Pholiota destruens*, cause 92 percent of the loss (*14*).

The cytospora canker, which is caused by *Valsa sordida*, is widespread under forest conditions. Its occurrence is highly correlated with the vigor of the trees. The canker is primarily a disease of young trees and therefore is seriously damaging to cuttings in nurseries and plantations. The disease tends to be more prevalent in stands injured by fire or on trees located on unfavorable sites.

Black cottonwood growing outside its native

TABLE 3.—*Black cottonwood site classification table* [1]

Age (years)	Site class					
	I		II		III	
	Total height	Diameter breast high	Total height	Diameter breast high	Total height	Diameter breast high
	Feet	*Inches*	*Feet*	*Inches*	*Feet*	*Inches*
5	25		21		16	
10	47	5. 7	43	4. 8	33	3. 6
15	72	9. 5	59	7. 1	46	5. 9
20	95	12. 5	79	9. 0	59	6. 5
25	111	16. 0	92	12. 0	72	8. 0
30	118	20. 0	102	14. 5	82	10. 5
35	125	22. 0	108	17. 0	89	12. 0

[1] Data from Hesmer, Das Papelbuch, cited by Smith (*11, 12*).

habitat is highly susceptible to disease. Commercial planting of it in Europe has been largely discontinued because the species has suffered so severely from attacks of bacterial canker (*11*).

RACES AND HYBRIDS

Black cottonwood varies throughout its range, differing with both latitude and altitude. Photoperiodic studies of black cottonwood specimens collected from various parts of the species' range and planted under uniform environmental conditions in the vicinity of Boston, Mass., showed that the time of height growth cessation varied inversely with the latitude of the plant's origin. Trees from a uniform day-length zone stopped height growth on a date directly correlated with the length of the frost-free season in the specimen's original habitat (*6*).

Adaptation of *Populus* species to various habitats differing in length of frost-free season is effected by a genetic mechanism that controls the duration of seasonal period of growth. The photoperiod or length of day serves as a timing device for this mechanism (*6*). With respect to seed source—

1. Seed from northern long-day races planted in southern latitudes having a long growing season are likely to produce trees that will stop height growth early in the season, and thereby become dwarfed.

2. Trees produced from seed of trees growing in a region having a short growing season, such as high altitude habitats of mountainous areas in the southern parts of the range, may be expected to react the same as northern long-day types. Seed collected in such habitats, therefore, are not recommended for use in the same latitude at lower elevations or at more southerly latitudes.

3. Seed from trees in a long growing season habitat in any particular latitude should be avoided for use in areas having shorter growing seasons either at higher elevations in the same latitude or at more northerly latitudes. Trees from such seed are susceptible to early autumn frost damage in the latter habitats.

One natural hybrid, Parry cottonwood (*Populus* ×*parryi* Sarg.), is native to southern California. The hybrid *Populus* ×*generosa* Henry was developed in England. It is a F_1 hybrid between *P. angulata* and *P. trichocarpa* (*9*).

Revised from "Silvics of Black Cottonwood," by Arthur L. Roe. U.S. Forest Serv. Intermountain Forest and Range Expt. Sta. Misc. Pub. 17, 18 pp. 1958.

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